From LWS to ILWS
and Norwegian Priorities

Bo Andersen

Norwegian Space Centre

18.12.2002

ILWS Requirements

- ILWS may have broader goals, motivation and requirements than LWS.
- Predictive capability still too small so scientific understanding must be main driver.
- Application side has proven useful to get funding for LWS, should not be oversold for ILWS.
- Coordination and possibly integration required with existing international “networking”.

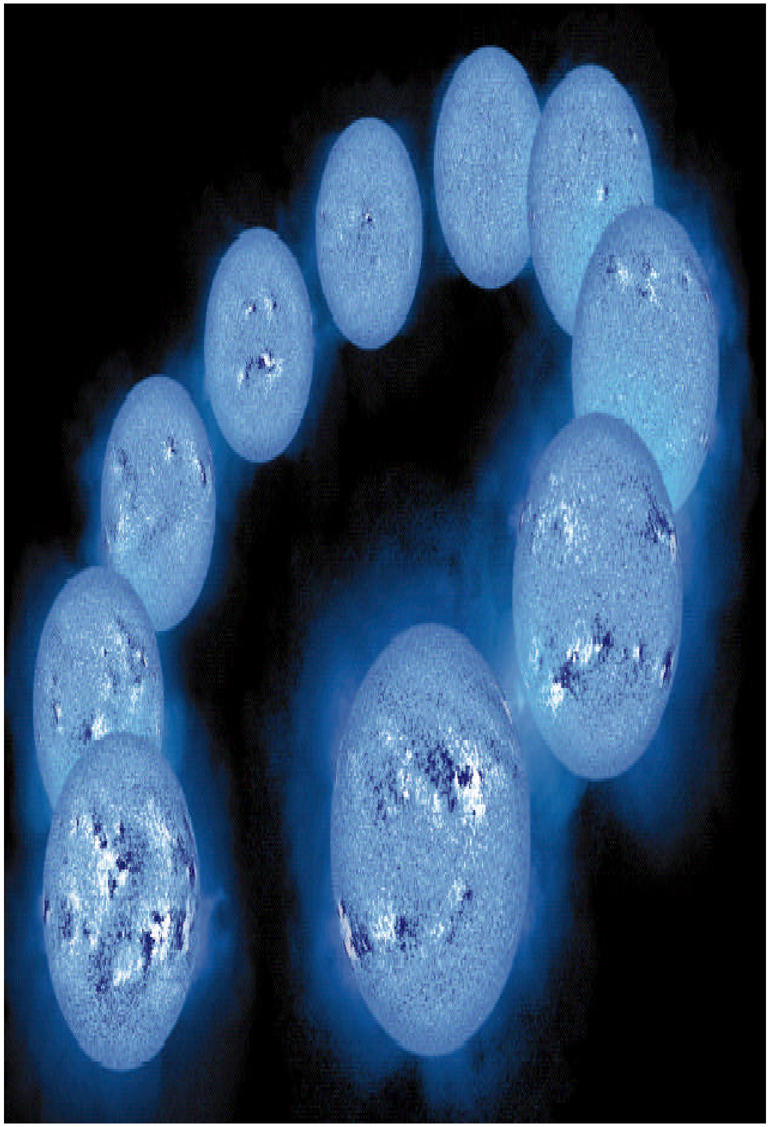
What is ILWS?

- Core space infrastructure from major agencies.
- Add on from other agencies and institutions
  - Payload provision
  - Technology development
  - Theory and modelling
  - Supplementary missions
  - Other observational tools (ground based, rockets, archives)
  - Education and outreach
  - Service providers

Norwegian Priorities (1)

- Historical tradition in studies of Sun-Earth relationships (Birkeland & Størmer).
- Build up of solar physics from the 1950-ties.
- Scientific infrastructure, ARR, ALOMAR, SvalRak, EISCAT.
- Participation in several recent space missions: POLAR, Geotail, SOHO, Cluster.
- >85% of Norwegian space science is within solar-terrestrial physics.

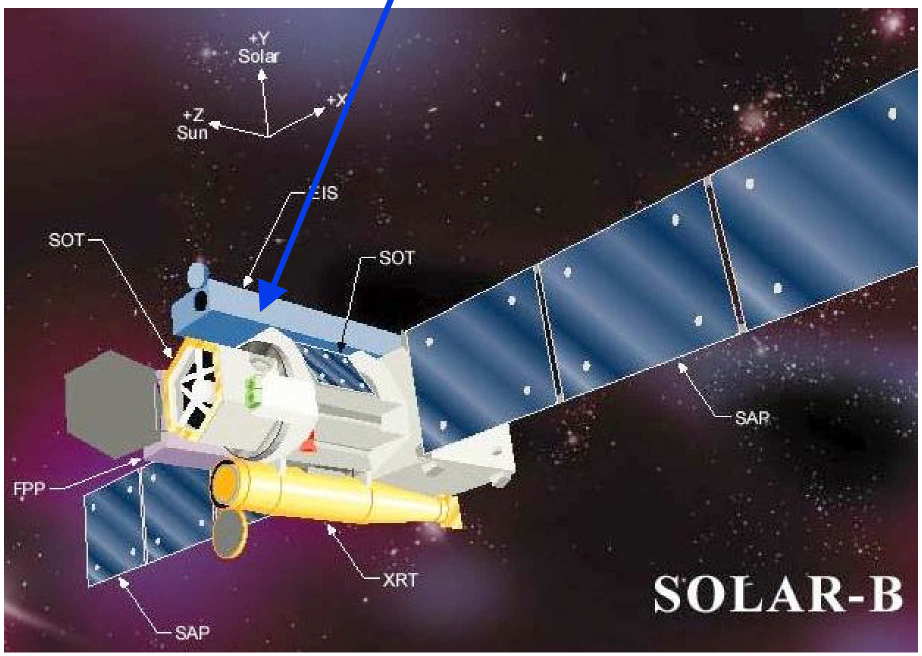
Norwegian Priorities (2)



- **To gain insight and understanding of the underlying physical processes governing:**
  - **The heating of the upper solar atmosphere.**
  - **The exited and structure of solar p-modes.**
  - **The microphysics of the auroral zone and polar cusp**
  - **Middle atmosphere dynamics**
- **Use of geographical advantage, the ESA membership and other suitable bilateral partnerships.**
- **National financing make pure non-ESA satellite projects difficult.**

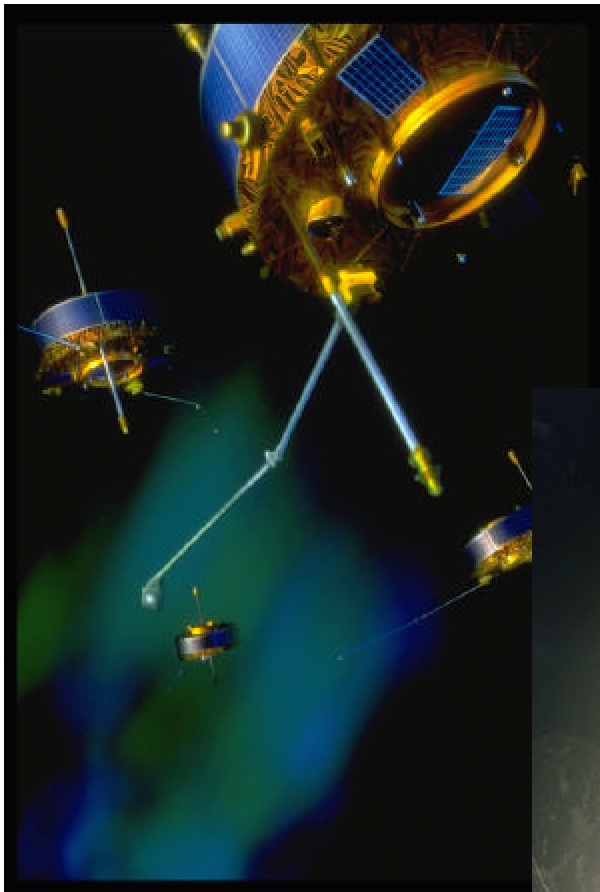
Solar Physics-Securing Continuity

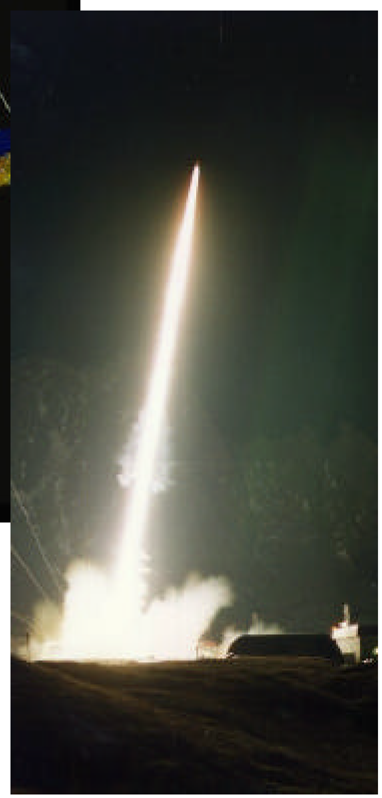
UiO with MSSL



- Clear line in priorities:
  - HRTS (rockets/shuttle)
  - SOHO
  - Solar B
  - SDO
- Strong in solar physics due to clear will to prioritize.
- Major setback for the future of solar physics in Norway with the non-selection of the two SDO proposals.
- Solar B and Solar Orbiter can only partially remedy this problem.
- More theory/modelling is needed to ensure the predictive power of an ILWS programme.

Space Physics-Complementary Tools



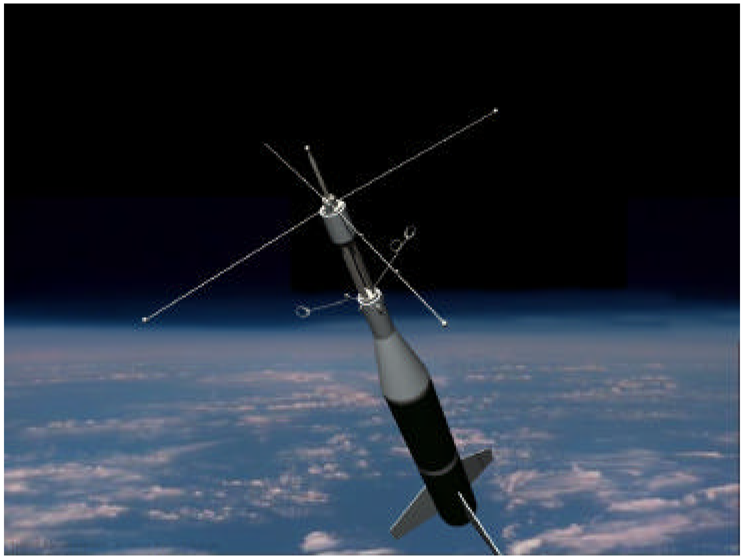


- Combination of satellites, sounding rockets and ground measurements to gain added value.
- Strong participation i Cluster.
- Continuity required!
- For internationalization to ILWS it is necessary to look at both the STP and LWS missions.
- MMS, GEC as well as MC missions of interest to Norway.

Leading Infrastructure

- Andøya Rocket Range (69ºN), more than 700 launches since 1962. 14 in ten hours this summer. The main polar launch site.
- SvalRak (79ºN), unique location in the polar cusp.
- EISCAT with sites on Svalbard in Norway, Sweden and Finland, both in the auroral zone and in the polar cusp.
- SvalSat is becoming the leading ground station for polar orbiting satellites.

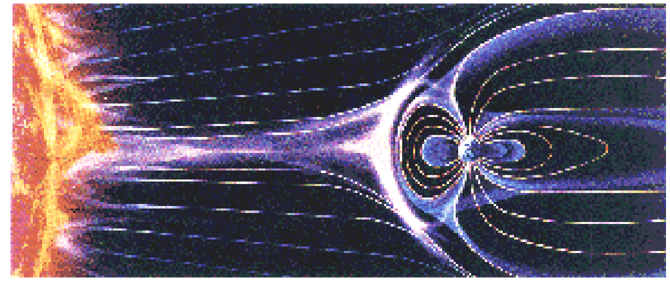
New Approach to Rockets



- **Do only what satellites or ground based instrumentation cannot do:**
  - **High spatial and time resolution, and**
  - **Close links with other instrumentation, and**
  - **Low ΔV, specific conditions and directions, or**
  - **Altitude below 130 km**
- **Lower costs to get more launches and data:**
  - **Extremely small payloads (8 kg, 50 mm Ø, 15-20 k€) up to 110 km.**
  - **Recovery of medium sized and large expensive payloads up to 150 km**
  - **Use of standardized payload module and support infrastructure (Hotel Payload)**
  - **Increasing use for education and outreach**

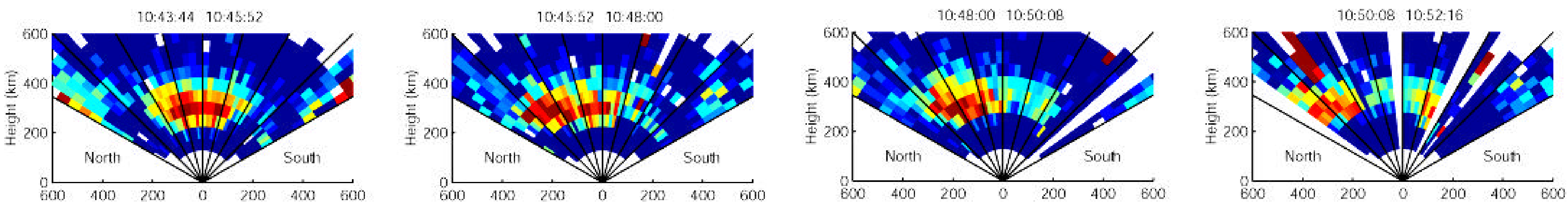
Svalbard- A Unique Location

- Ideal location for daytime aurora
- Easy access, moderate climate and good general infrastructure
- Extended suite of scientific infrastructure
- Data reception from all orbits of polar orbiting satellites.



Plasma clouds with EISCAT

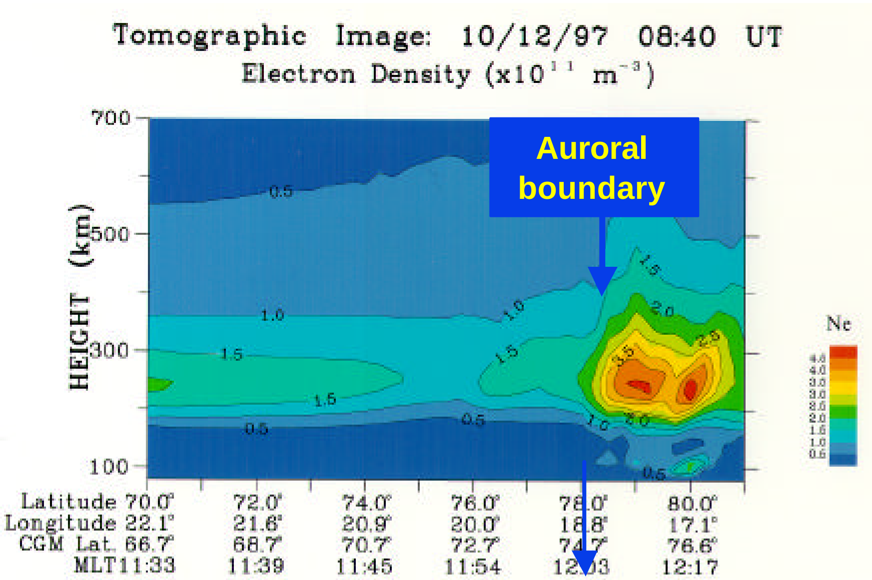
- Plasma clouds are created near the daytime aurora and drifts over the pole.
- EISCAT Svalbard Radar is a versatile tool to study the ”stormy” surroundings of the aurora - the wind and density of the electron plasma.

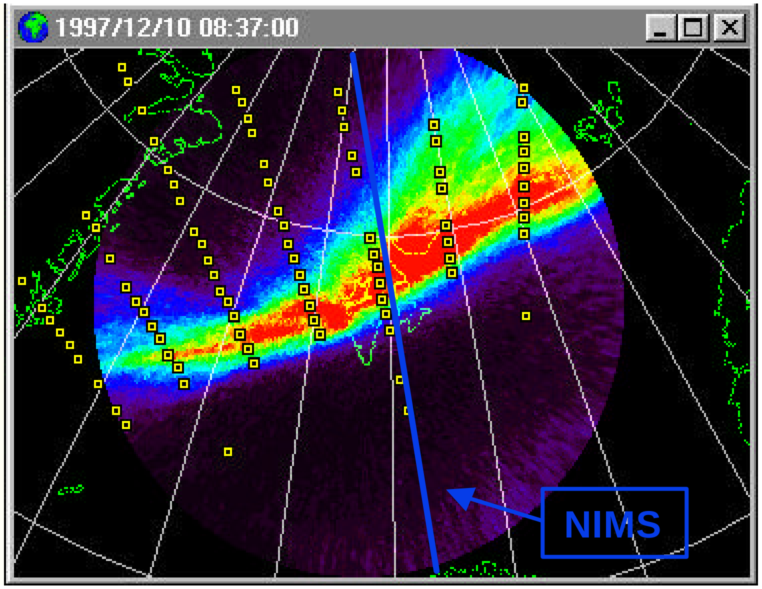


A big plasma cloud drifting northward on 19 December, 2001. In the rightmost picture we see a new cloud forming south of Svalbard.

Unresolved problem

What causes decametre scale plasma irregularities in the cusp for the HF radar to backscatter from?



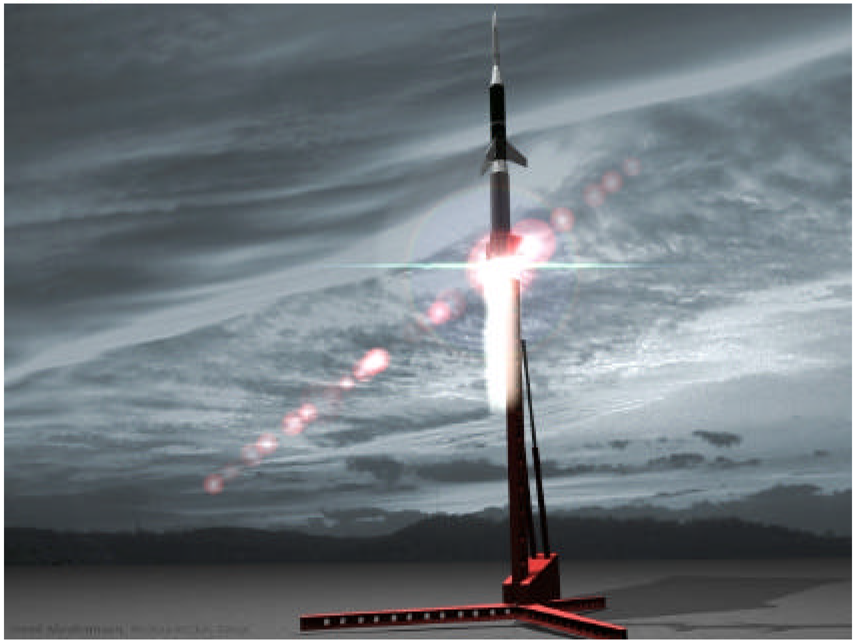


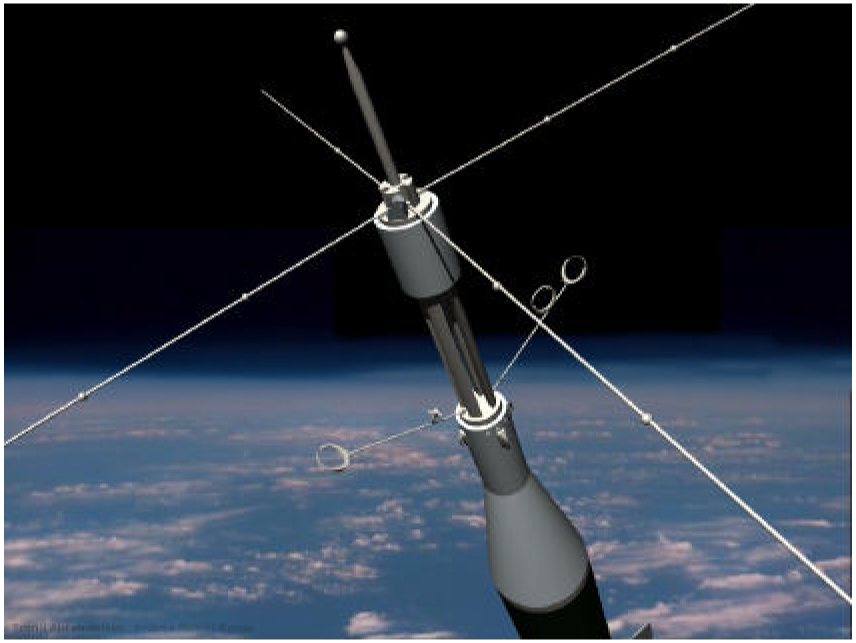
Gradient drift instability growth rate

$$g = -\left(\frac{1}{n_0}\right)\left(\frac{\Delta n}{\Delta y}\right)\left(\frac{E}{B}\right)$$

⇨ **5-10 min**

ICI-1 Investigation of Cusp Irregularities





ICI-1

- Electrical fields (DC/AC): UiO
- Positive ionprobe: FFI
- High energy particles: UiB
- Magnetic fields :   CETP, Velizy
- Current measurements: LPCE, Orléans
- Payload: 50 kg
- Configuration: Nike/ Improved Orion
- Apogee: ~320 km
- December 2003

Conclusions

- **Norway is strongly supportive of an ILWS programme with a primary science and a secondary application justification.**
- **Need a broad band of observational and theoretical tools.**
- **Unique contributions from Norway in fields of sounding rockets and infrastructure.**
- **On satellite side ESA connection is required for Norwegian national funding.**
- **Requires close co-ordination in mission planning and payload selection, specially between the major agencies.**